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LOOKING AT MANAGEMENT THROUGH ITS INSTRUMENTS
A genealogical analysis of instrument-based approaches of management[1]

Franck Aggeri and Julie Labatut

Abstract

Various social science disciplines are currently witnessing a revival of theoretical approaches based on management instruments. The common feature of these approaches is that they consider management instruments as a starting point to study organized, strategic action. This article introduces a framework to distinguish the notion of management instruments from that of management tools or settings. It then proposes a genealogy of these management instrument-based approaches, by placing them in the theoretical and practical contexts in which they emerged. The originality of contemporary developments concerning these instruments, compared to former studies, is thus evaluated. The article concludes by arguing for the broadening of the management science research agenda, beyond the micro-analysis of local instruments, to include the conception of strategic multi-level settings consisting of a combination of actors and instruments.

Keywords: Management instruments, management tools, management technology, management research, genealogy, organization studies

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Introduction

The social sciences and especially management science are currently experiencing a revival of theoretical approaches that study organized and strategic action through the instruments used to carry out that action. Rather than analyzing management through its substance and discourses, or through managers' intentions, these approaches focus on the technical, scientific or management instruments that are employed to conduct collective action and produce new strategic capacities. They can be seen as a critique of instrumental rationality: the research question they address concerns not the design of effective, axiologically neutral tools, which supposedly reflect the expression of intention but, on the contrary, the – often unintentional – effects of instruments on the dynamics of collective action. From this more critical and reflexive perspective, instrumentation not only serves to mediate; it also constitutes a highly favourable form of intervention to construct new capacities for action (Joas 1999), and induces change in activities and organizations.

This interest in management instruments is nothing new. It appeared in the 1960s and seems to be inextricably linked to a contemporary empirical phenomenon: the proliferation of (management or technological) instruments, associated with the birth of new actor figures (the development of engineering) in large organizations since the late 19th century (see Chandler 1977; Hatchuel and Weil 1992). Such profusion would not have drawn researchers' and managers' attention had it not been for its unexpected effects, including: the unorthodox use of certain instruments, the stability of some of them and of the behaviour of the actors concerned, despite discourse on organizational change; and repeated failures and rapid obsolescence of reputedly modern instruments (e.g. expert systems, decision-making tools, ERP, operational research, etc.). Despite recurrent critiques by researchers and even by managers themselves, the proliferation and sophistication of contemporary instruments are evidenced everywhere, along with their tendency to colonize new fields of action in management (design, health, culture, science, etc.) (see Moisdon 2005a). This enigmatic phenomenon has spawned various research traditions in management science, which have investigated the effects and

uses of instruments on organized action and on the development of new management capacities (see Berry 1983; Hatchuel and Weil 1992; Moisdon 1997; David 1998; Lorino 2005; Miller and O'Leary 2007; Power 1996; Pezet 2001; Hasselbladh and Kallinikos 2000). Studies presenting similarities from an epistemological point of view have been undertaken in other disciplines such as the history and the sociology of science and techniques (see Hacking 1983; Joerges and Shinn 2001; Callon and Muniesa 2003), the sociology of public action (Lascoumes and Le Galès 2004), and ergonomics (Rabardel 2005). What are the hypotheses and objects underlying these theories? Are there common epistemological hypotheses? How fertile are these theories and to what extent can they shed new light on the empirical phenomena of management?

The aim of this article is to consider the development of theoretical instrument-based approaches from a genealogical angle[1], that is, by analyzing their roots and the relations between them, and by putting them back into the context of the theoretical and practical debates in which they were conceived and disseminated. A review of the traditional literature would tend to identify and compare these different theories by analyzing their explanatory power in relation to their respective ontological and epistemological positions. The genealogical approach, on the other hand, aims to understand the way in which differing theoretical frameworks are historically situated (Miller and Napier 1993). This article does not claim to provide an exhaustive overview of these theoretical approaches and their genealogy, but rather to define the main lines of the research project seeking to understand management through its instruments. By studying the development and diffusion of concepts, the genealogical approach seeks to highlight the historical background of ways of perceiving and analyzing new research subjects. The advantage of this approach is twofold. First, it affords an opportunity to stand back and take a critical standpoint that is not possible with a naturalized or a-historical approach to concepts. Second, by focusing on the conditions in which instruments emerged, the analysis also seeks to investigate the relevance and transposability of theoretical frameworks in vogue in managerial contexts that differ from those in which they developed. This then enables us to explain more adequately the convergences and differences of instrument-based aproaches, and to show more clearly their theoretical

fecundity from two points of view: comprehensively (to account for contemporary management practices) and prescriptively (to endow the actors with new capacities for reflexivity and steering of their own action).

This article is divided into four sections. The first section frames the terminology used. The distinction between tools, instruments, machines, settings and management technologies is introduced. The second part presents the first studies that sought to formalize the management tool-based approach in France and in the UK in the 1970s and ‘80s, and which focused on the structuring, even disciplining, effects of the instrumentation of management. The third part analyses contemporary developments that study the rationalization of collective action, as well as the contemporary forms and uses of technological and managerial instrumentation. The conclusion makes some suggestions for a research agenda, with an emphasis on the importance of going beyond an elementary analysis of instruments and considering their positions within strategic devices or systems.

From management tool to management instrument

Why talk of management instruments rather than using similar terms like management tools, management devices or management machines? The choice of terminology is by no means neutral and warrants some consideration.

The most frequently used term in management science is management tools. In everyday language, a tool is an appendage of the hand; the tool of a craftsman is the utensil of his work. Use of the notion of a management tool in the literature or in corporate settings reflects this modest image of management. The management tool is this appendage of the manager, the utensil of the “artisan-manager”. Operating reports, schedules, indicators, accounting tools, etc. are designed above all to be useful. This operational orientation is the guiding line for most of the thinking and strategies of

managers, consultants and researchers specialized in the tools of accounting, finance, marketing and strategic planning.

An instrument, on the other hand, is the product of an intellectual operation on a higher level. Pianists, surgeons or scientists are not only craftsmen or -women; they make the most of their instruments, drawing on a mixture of skills and practices. Scientific instruments, for example, enable researchers to design and carry out highly complex experiments. They are often themselves the product of design. Figuratively speaking, instruments are also political. They are vehicles of intention, of force, and are intended to steer behaviours and produce effects. Economic or public action instruments have some of the features of management tools but clearly encompass a political dimension.

Hence, the concept of management instruments, in addition to its materiality, its artefactual dimension – very popular in organization studies (Orlikowski 2007; Pentland and Feldman 2008) –, encompasses the two basic dimensions of a management activity: first, management instruments are the product of intellectual thinking (a usage doctrine and models); and, second, they have an implicit or explicit political dimension that tends to be revealed in organized and applied activities. In other words, the assumption of neutral instruments is not robust since instruments are found in concrete situations.

From an epistemological point of view, studying management tools necessarily leads to a shift in the focus of research: attention is not limited to the design of artefacts but also includes their uses in concrete situations and the effects they may have or effectively do have on behaviours. From this perspective, instruments are not neutral. They are intended for certain uses and are the outcome of a process of intervention, of a specific way of producing knowledge on new objects and phenomena (Hacking 1983). The instrument acts like an “epistemic” machine that alters the perception of reality, allowing for the construction and interpretation of new phenomena.

These ideas are helpful to identify more clearly what distinguishes managerial instruments from other types of instruments. It is not the nature of the organization concerned that makes the difference, for management instruments are found in all types of organization, irrespective of their size or core business, including religious organizations, NGOs and scientific organizations, for example. Nor is it the nature of the instrument, for there is no reason to limit management instruments to tools designed by and for managers. Most material technologies, which are artefacts, do not relate to a precise managerial project; yet they are likely to acquire a managerial dimension when they effectively induce changes to relationships and learning. In other words, an instrument initially designed with a scientific or technical aim, can also become a management instrument. For example, the water meter was initially designed as a technical device to monitor a physical phenomenon (the flow of water) but came to be used to calculate water consumption. In so doing it paved the way to the development of new economic and management services (billing, subscription, etc.) for individual customers (Hatchuel 2000).

It is therefore the activities to which instruments contribute, irrespective of their nature, that make them management instruments. An instrument will be qualified as “managerial” if it participates during its existence in three basic managerial acts: delegating, evaluating, and coordinating (Hatchuel and Moisdon 1993). On this basis, we can consider the conditions in which instruments are endowed with a managerial dimension (see Box 1). In the rest of this article we use the term “instrumentation” to denote the activities pertaining to the design and use of instruments in a specific field, and which relate to identifiable forms of expertise (e.g. accounting or financial instruments).

A similar concept is that of management technology. Etymologically, a technology refers to a description, to organized knowledge, to the codification of techniques and instruments, for example. Therefore, a management technology denotes a broader category, less directly related to a particular artefact, than does the elementary concept of an instrument. The balance sheet is an accounting instrument whereas accounting

encompasses a set of techniques, knowledge and tools that, strictly speaking, constitute a management technology.

Another notion used extensively in the management and social science literature is the management setting or *dispositif*. The management setting denotes an arrangement of instruments and actors. It relates to a level of analysis that is less elementary than that of the instrument. The arrangement between the different parts and the possible ways of achieving it are more significant here than the effectiveness of each of the parts (see Foucault 1984; Girin 1996). The management setting is still the product of a deliberate managerial act: it is designed, arranged and altered with a specific objective. From this perspective, a strategy is not only a matter of the manager's vision. It can be seen as engineering, consisting of the activity of designing settings that structure collective action and make it possible (Aggeri 2008). The following example of the setting for genetic selection of animals illustrates this point.

Box 1: The managerial dimension of scientific and technical instruments

The example of the animal genetic selection setting illustrates this arrangement of scientific and technical instruments with a managerial objective (Labatut 2009). Genetic selection is based on the arrangement of complex instruments involving research and development organizations and selection cooperatives in the design and use of scientific and technical instruments. These instruments thus make the selection of animals and the production of genetic progress possible. Genetic selection can be supported by genetic indexes (which assess animals' genetic potential, based on a statistic model) or artificial insemination (a technique for calculating mating between the best animals). The analysis of these instruments has revealed that apart from their scientific dimension, they also have a managerial dimension. They are used as instruments of coordination (use of genetic indexes to organize relations between sellers and users of the genetic progress created) and evaluation (evaluation by the State of the effectiveness of selection devices, through the increasing use of genetic indexes and the spread of

artificial insemination). Scientific instruments for improving animal populations can become instruments for managing markets and collectives.

The design dimension is not however present in the concepts of management machines (Girin 1981) and management routines (Nelson and Winter 1982; Feldman 2000, 2003; Feldman and Pentland 2003). These two terms denote systems of instruments that are autonomous and have gradually escaped their designers' intentions. Unlike management settings, the machine has an overall coherence and automatic effects from the start. A contemporary example would be the current financial crisis which largely defies straightforward causal analysis. To reach a plausible explanation, one has to study the constitution of autonomous management machines which are constantly altered by the integration of new elements (e.g. sub-primes) whose systemic effects are difficult to model and to anticipate.

Routines have points in common with machines. They are cognitive schemata which are taken for granted and produce their own effects, independent of the will of the actors that implement them (according to the classical approach to routines, criticized in more recent studies of Feldman 2000, 2003; Feldman and Pentland 2003). The difference between management routines and management machines nevertheless stems from the degree of complexity considered, on the one hand (a routine denotes a simpler abstract schema than a machine), and the possibly immaterial nature of the routine.

Now that these concepts have been defined and differentiated, we will turn to the genealogical analysis of the various theories of management instruments.

Theories of the structuring instrument

The routine-based approach or critique of the instrumental reason of management

For as far back as the development of organized economic activity goes, one finds examples of management instruments. Since antiquity, the development of commercial

and administrative activities has been accompanied by that of new management tools such as common rules on damage which enabled the captain of the ship to jettison damaged merchandize without obtaining prior authorization from the owners thereof (see Segrestin and Hatchuel 2009). In the Middle-Ages in Italy, the development of trade with distant lands was made possible by the birth of a new instrument: double-entry bookkeeping[3]. Historians of business enterprises have shown the unprecedented growth of the instrumentation of management in the 19th and 20th centuries, with the birth of big firms. Philippe Lefebvre (2003) has studied the beginnings of the intermediate hierarchy and workshop management instruments in large industrial firms of the 19th century, whose rapid growth allowed for the application of the scientific organization of labour based on Taylor's work. Alfred Chandler has analyzed the emergence of the large multi-divisional firm that went hand in hand with the development of two specific instruments: organizational structures, and cost control (see Chandler 1962).

The movement intensified further after WWII, with the emergence of new scientific research, cost control disciplines with a largely instrumental purpose. Operations, strategic planning, marketing, scientific management, and information processing are all fields of expertise where specialists produce instruments for the purpose of supporting the growth of large organizations. These new disciplines conceive of their role as part of a normative project: the design of instruments is part of a rationalization movement aimed at improving the effectiveness of managerial action. From this perspective, the instrument is assumed to be "neutral". It is the means to enhance decision-makers' rationality and to endow them with calculation capacities in a context of bounded rationality.

Instrumental rationality has been largely criticized. The first type of criticism has been through the behavioural theory of the firm (behaviourism). Popularized by the work of Cyert and March (1963), the behavioural approach has a very different perspective: the firm is seen no longer as a processor of information or as the outcome of the deciders' intents, but as a political coalition whose behaviour is guided by the execution of routines. From this point of view, the research aims to explore no longer the

effectiveness of decisions but, on the contrary, the supposedly irrational behaviours of the members of the organization. To explain series of apparently chaotic decisions in universities, Cohen, March and Olsen (1972) proposed the “garbage can model”. Their analysis maintains obvious intellectual similarities with the strategic analysis of organizations developed in France around Michel Crozier, with regard to both the type of subjects studied (large bureaucratic organizations) and the concepts (the notion of a zone of uncertainty is not unrelated to that of “slack”, proposed by Cyert and March). One difference does however stem from the role that the behavioural theory of the firm attributes to a particular type of instrumentation: routines. The firm encodes inferences in the routines that guide behaviours (Levitt and March 1988). These routines are not necessarily efficient because they stem from the interpretation of past experiences. They act as filters, amplifying the cognitive biases of the organization. Nelson and Winter (1982) argued that routines are the behavioural expression of the firm. They correspond to any regular and predictable behaviour resulting from the firm’s history. When they are interiorized, they become the firm’s natural state. From the end of the 1960s, management research also investigated detailed interactions between technologies and organizational routines (see Hickson et al. 1969).

Originally the notion of a routine nevertheless encompassed a restrictive view of the role of instrumentation. The research question aimed to explain not change but the inertia of organizational systems and the emergence of technological and organizational trajectories stemming from a largely evolutionary theory of collective action. This was largely consistent with the subjects studied by routines scholars – bureaucracies – and with their scale of analysis – meso – which was intended to model the behaviour of populations of organizations or firms. Contemporary developments on routines have gradually departed from this ballistic approach. Today they seek to revert to a more comprehensive approach by opening the “black box” of routines and studying the gaps that may exist between the general definition of a routine (the abstract pattern) and its implementation (ostensive and performative dimension) (Feldman and Pentland 2003).

An invisible technology or the tools/organization question

From the late 1970s, a French school of management studies developed in the wake of the work produced by the *Centre de Gestion Scientifique* (CGS) of the *Ecole des Mines de Paris* and the *Centre de Recherche en Gestion* (CRG) of the *Ecole Polytechnique*. It is no coincidence that this approach emerged and developed in engineering schools where the tools and models of scientific calculation and operations research were taught.Apart from their initial connection with the scientific tools derived from operations research, French management studies were also characterized by their fieldwork. In other words, they were not developed in laboratories. From the outset, they were conceived with the idea of collaborative research with organizations, and were labelled intervention-research. A new conception of management research thus emerged, in which modelling and management tools occupied the centre stage (Moisdon 1984, Hatchuel and Molet 1986). With this perspective, the idea was to scientifically model industrial problems (investment choice, production management, etc.), with the aim of developing decision tools that have an impact on corporate management. Several research projects were undertaken with the objective of analyzing the real life of these tools in firms. The researchers were surprised and puzzled to find that, on the ground, the take up of management tools was sometimes far removed from the designers' or managers' initial intentions. Based on their analyses of this phenomenon, the researchers brought together two research traditions that were separate in the academic world: management science (operations research, decision aid, etc.) and organization studies.

These researchers first sought to contribute to the revival of debates revolving around operations research (OR). In the 1970s the discipline's status wavered between a science, with its own objects, and a technology which could be used by firms to solve problems. It experienced a period of crisis reflected in recurrent questions on the lack of implementation of tools and the simplifying nature of the underlying models. Some authors, like R. Ackoff, criticized OR's focus on tools, when in fact problems were far more complex. At the time, Ackoff distinguished the notion of a problem, which he saw

as too simplifying, from what he called a mess, or a hotch-potch of largely disconnected issues (Ackoff 1979). Management researchers contributed to the debate on the discipline's future by redefining its role within a broader issue: the nature and efficiency that can be expected from formal modelling for studying and running organizations. They posited that any modelling of decision aid contained an organizational model that was usually implicit[5]. The research question was then to study the gaps between the abstract yet performative organization incorporated in tools, and the concrete organization that could be observed. From an epistemological point of view, these studies followed on from Herbert Simon's seminal work on the sciences of the artificial, in which substantive rationality, which is independent of the modes of calculation and the tools mobilized, is replaced by a procedural rationality, which is inventive and teleological, and depends on artefacts designed by humans to multiply their capacities for action (Simon 1969).

From the early 1980s this theory of management tools turned into a more political approach to management instruments under two intellectual influences. The first was the work of Cyert and March, on the existence of local logics which, in organizations, are structured by routines that encode existing knowledge.

The work of Michel Foucault was the second, equally structuring influence on this research stream – albeit one that was not acknowledged at the time. Foucault developed the idea that contemporary forms of government can be captured in the details of their instrumentations. He proposed an unusual analysis of the modalities of government, seen not through the substance of power or its intentions, but through its concrete actions. In particular, he analyzed the emergence, from the late 18th century, of a new technology of government based on surveillance, control and examination instruments and techniques that made it possible to govern individuals and populations from a distance, and that were embedded in systems of heterogeneous knowledge/power.

A first synthesis of these works was published in 1983 in a report by Michel Berry for the French Ministry of Research, headed “An Invisible Technology”. The author noted the implementation of management instruments of greater or lesser degrees of complexity, in the management of organizations. He argued against a representation of management as a matter of intention, where these instruments might be the discreet and loyal auxiliaries of power[4], and showed that, on the contrary, management instruments (such as operating reports or indicators) have performative effects on reality; they shape behaviours and decisions, sometimes beyond what actors are actually capable of imagining. Based on clinical and longitudinal studies, management research showed how material support, rather than will, drives action. It followed that it was more logical to study the procedures and tools implemented, rather than the intentions announced or the exercise of visible power. This approach then led to the formulation of the thesis of management parameters, in terms of which, at any point in time, agents prefer numeric parameters and therefore use only a very small amount of information. Among those parameters they prefer those on which they feel judged, and then logically make decisions in such a way as to optimize the judgments that they believe are being made about them. Hence, when urgency and the size of an organization make it necessary to sum up information into synthetic and specialized indicators, there are many cases where different people make identical choices, even though they may seem surprising from the outside. In a perspective close to that of March, the author points out that *“these behaviours are however rational, as everyone adjusts logically to his or her local environment. The organization is simply a juxtaposition of relative logics whose global rationality may seem problematical”* (Berry 1983: 13). Moisdon sums it up neatly: *“a management technology is prescriptive: it makes behaviour visible and guides it, disciplines it; it even creates actors, assigns roles to them, and defines a system of values by specifying how performance is measured and how the actor shall coordinate with others”* (Moisdon 2005a: 165).

Since the 1980s this approach has spawned a wide range of empirical studies in various fields (healthcare systems, production management, public management), where the role of management tools in the investigation of organizational functioning and its

unexpected effects – far from the effects of conformation originally expected – is analyzed. We witness a significant return to the initial terminology of management tools, reflecting a focus back onto tools and organizations. In the reference volume edited by Jean-Claude Moisdon and published in 1997, which brings together twenty years of empirical research undertaken at the CGS on management instrumentation, Moisdon defines the management tool as *"a formalization of organized activity, of what it is or what it will be (all the reasoning and knowledge needed to inform the trilogy: plan, decide, control)"* (p.7). In this approach, a management tool is *"an abstraction, a model, small or large, which links up several quantities (productions, prices, number of defects, number of employees, etc.)"* (Moisdon 2005a: 131). The author distinguishes management tools from rules (which are prescriptive) and from management settings which, from a Foucauldian perspective, are *"arrangements in time and in space of people and things"* (*Ibid:* 136) and which guide them towards set goals.

Management instruments: a means for new explorations

The concepts developed in these early theoretical approaches focused on instruments that were nevertheless too limited to explain the contemporary transformations of collective action and the forms of instrumentation associated with them, or the types of activity that organizations had to manage. Since the 1980s research has focused less on the stability of behaviours than on the emergence of an economy of variety and intensive innovation. The aim has been essentially to understand the rapid changes in the objects of management, in management techniques, and in knowledge. The corporate world has been confronted with the emergence of the Japanese model (just-in-time, management by projects) and more flexible, decentralized management technologies to replace Taylor's model. At the same time, it has experienced the emergence of new information and communication technologies (NICT) which have triggered and fostered the emergence of new forms of networked organizations. Faced with these new empirical challenges, instrument-based approaches have been applied primarily in four ways.

English-language studies on NICT: critique of a deterministic view of technologies

The diffusion of new information technologies, computers and computer-aided techniques in the early 1980s aroused the interest of researchers studying technology-organization and technology-structure relations. This research stream produced seminal work such as that of Barley (1986) and of Orlikowski (1992) which, on the basis of Giddens' (1984) theory of structuring, criticized both a deterministic view of technologies that disregards the role of actors in the take up and change of technologies, and a view where technology is the product of human intention. For instance, Barley (1986) explored how, with the diffusion of medical imagery in hospitals, these technologies altered the distribution of roles and competencies, and thus participated in the transformation of organizations. Contemporary studies on questions of "socio-materiality" (Orlikowski 2007) and on the relations between organizational and technological dynamics (Edmonson et al. 2001, Orlikowski 1992) have been a continuation of that work[5]. The success of these researches in certain domains of management science, such as information systems, seems to stem primarily from the properties of the new information and communication technologies (NICT). The fact that these technologies are functionally integrated and tend to spread, clearly raises the question of the inter-organizational arrangements associated with their development.

The role of management instruments in steering change

Parallel trends, towards a better analysis of change and learning dynamics, are witnessed in streams of research focused on management instruments. The early studies on management tools first concentrated on the analysis of the stability of organizational behaviours. The aim was then to explain the failure of reforms and the use of instruments to ends other than those originally intended for them.

As Moisdon (1997) notes, the signification of tools changed gradually from the 1980s, from standardizing behaviours to creating and disseminating knowledge. The question was then less conformation than knowledge and the exploration of reality. Thus,

alongside the tools of investigation of organizational functioning, appeared tools designed to steer change and to explore new ground. From the mid-eighties, researchers studying innovative firms (Hatchuel and Molet 1986) focused on the role of management tools in steering change. This research question was systematized by Albert David in an article published in 1998 in the journal *Revue Française de Gestion*. David argued that management tools concretize managerial innovation processes which can be modelled according to successive cycles of design and diffusion (David 1998).
This exploration of the cycles of design and take up of management tools was pursued in the book edited by F.X. de Vaujany (2005). Various authors set out their theories, based on numerous empirical illustrations of the phenomena of take up of management tools in various contexts (information technology, marketing, accounting and financial tools, etc.).

Rationalizations and managerial techniques

From the 1980s and 1990s, some research on instrumentation took an historical turn. Instruments were considered not in terms of changes in micro-practices but as drivers of broader processes of rationalization whose dynamics were studied over longer periods of time. The question was no longer to analyze the immediate effects of instruments on organizations, but rather to understand how the emergence of techniques allowed for rationalization projects[6] which, in turn, relied on specific forms of instrumentation.

In this perspective, Hatchuel and Weil (1992) set the genesis of instrumentation in a more general framework: that of managerial techniques. This term encompasses not only instrumentation but, more broadly, the knowledge, actors and devices associated with it. The development of managerial techniques was inextricably linked to the birth of new “actor figures”, that is, processes of social differentiation attending processes of rationalization, and materialized in the appearance of new occupations, roles, statuses, rights (Hatchuel and Weil 1992) and knowledge. Managerial techniques accompanied the large waves of rationalization of firms in the past century. In the late 1980s, in their study of the wave of rationalization of artificial intelligence and expert systems, these

authors analyzed managerial techniques as modelling projects. From Taylorism to project management, and from accounting to computer-aided management, corporate history is punctuated by the invention and diffusion of new management "technologies" now inseparable from the professionalization of new management professions (accountant, organization engineer, quality control manager, etc.). Along with management tools designed with a view to obtaining agents' conformity (e.g. the standards of the scientific organization of work), the new generations of tools developed in firms over the past 20 years (e.g. expert systems, quality control systems, activity-based accounting) are based primarily on a logic of exploring innovative approaches and organizational functioning (Moisdon 1997). From this genealogical perspective, the idea has been to study the simultaneous genesis of new management objects and new managerial techniques. For example, at the end of the 1970s, in his PhD research, Eric Pezet studied the birth of a new managerial technique and a new management object at Berliet, which was subsequently generalized to the field of human resources: the classification grid (Pezet 2001). Today, management tools have spread into new areas of collective action that remained impervious to them for a long time, such as design (Le Masson et al. 2006) and CSR (Acquier 2007).

Based on the idea that "rationalization is a mythical objective, a sign of firms' progress", Hatchuel and Weil show that managerial techniques are based on "rational myths", that is, they are composed not only of an objective dimension but also of *"more metaphorical representations without which one can neither identify comprehensible fields of action nor mobilize potentially interested actors"* (Hatchuel and Weil 1992). The authors proposed a study in which managerial techniques were treated as though they consisted of three dimensions: a technical base, a simplified view of organizational relations, and a management philosophy. The management philosophy expresses the *"system of concepts that denotes the objects and objectives which constitute the targets of a rationalization"*. It defines the general aim in using this technique, even if that is not necessarily the goal pursued by the actors who adopt it.

The mounting turbulence of the environments with which firms were confronted did not dissuade certain management research streams from pursuing their project of constructing new managerial techniques based on new rational myths. One of the most ambitious projects embarked on by researchers over the past 20 years, in cooperation with consultants and certain firms, has been research revolving around management accounting (Johnson and Kaplan 1987; Lorino 1991). This research was based on a critique of analytical accounting, which various authors have shown to be unsuited to the context of intensive and variety-based economies (explosion of indirect costs – design, marketing, sales, administration, etc. – which invalidates the rule of imputing indirect costs as a pro-rata of direct costs). Studies on management accounting sought to rebuild the foundations of a new strategic management control, based no longer on homogeneous operations and entities, but on a logic of processes and projects, involving a simultaneous revision of structures and measuring instruments (see also Ecosip 1993; Garel 2003). After a phase of initial enthusiasm, the principles and effects of these managerial techniques were, in turn, criticized. Some critics considered that the focus on costs – which are measurable – introduced a bias into the rationale underlying this approach (see Burlaud and Simon 1997).

The contributions of other disciplines to instrument-based approaches

This research on managerial techniques had strong intellectual similarities with certain research developing in the UK at the time, based on a Foucauldian approach and a genealogical investigation of the role of instrumentation in the transformation of collective action.

Two currents can be identified. The first emerged in the 1970s, based on the early work of Marx and Weber on the role of accounting techniques as a condition underlying the rise of capitalism. This research stream came to be known as *"critical management studies"* and *"critical accounting studies"*. The seminal scholar was Anthony Hopwood (1974) of the London School of Economics (LSE). In 1976 Hopwood founded the reference journal in this field: *Accounting Organizations and Society* (AOS). This critical

approach saw accounting and management techniques and practices not as static or as purely technical phenomena but rather as drivers of the reconfiguration of power relations within organizations and society.

From the 1980s and '90s, the intellectual position of this research stream shifted: Foucault gradually replaced Marx as the core reference (Neimark 1994). The key research question was less relations of domination than the way in which subjects are transformed into governable and calculable objects through the application of accounting technologies. As Carter et al. (2002) summed it up: *"the work of Anthony Hopwood (1987) introduced an archaeological analysis to accounting; while through the studies of Miller and O'Leary (1987), Foucault's work on governmentality was to become elevated to an influential position within the field"*. This approach grew consistently within Critical Management Studies (McKinlay and Starkey 1998). One of the milestones in its growth was the creation, in 1990, of the journal *Critical Perspective on Accounting*. During the past decade, relations have been established between English-speaking and French researchers around the importance of Foucault's work in the analysis of management and government (Hatchuel et al. 2005). By studying instrumentation, this research programme undertakes in-depth investigation into collective action and modes of government in organizations.

Apart from the reference to Foucault, recent developments in this Anglo-Saxon research stream are characterized by the mobilization of concepts from the philosophy and sociology of science and techniques (Hacking 1983; Pickering 1992; Morgan and Morrison 1999; Callon 1980). One of the key authors is Ian Hacking. In his book *Representing and Intervening* (Hacking 1983), he shows how representations of reality are based not only on theories but also on observation techniques. Most importantly, scientists do not only represent things, they intervene, alter realities, act upon things, and thus create new phenomena by means of instrument design. Whereas philosophers of science traditionally considered the "representative" dimension of scientific instruments and models, Hacking highlighted the way in which instruments alter the world that they are supposed to represent. From a similar perspective, social science

studies seek to show how the design of instruments contributes actively to building new scientific objects, yet also constitutes a mechanism of integration of scientific disciplines subjected to centrifugal forces of differentiation (Joerges and Shinn 2001). The contributions of these different disciplines converge, so that instrumentation is considered as a point of entry to study the dynamics of science, and to show that the management dimension is increasingly crucial in the governance of science[7].

In this research stream focused on instruments, the study of processes of institutionalization (creation of markets, of professional fields and of institutional environments) now occupies a preponderant place. On a general level, Hasselbladh and Kallinikos (2000) argue that the analysis of the process of institutionalization and managerial rationalization cannot be considered separately from the instruments that codify and stabilize schemes of action. As Barbara Townley points out, for a field to be managed or governed, it has to be made knowable (Townley 1997). Power (1996), through his work on audit techniques, argues against traditional views of this technique that see it as neutral and disregard its structuring effects. Power shows that the "auditable" character of an activity or product is not a "natural property" of that activity or product; instead, it is the result of an intense process in which, through the audit, the legitimacy of the knowledge base that this technique mobilizes, and the appropriate environment in which the audit takes place, are constructed. Power's work has made it possible to identify the processes of institutionalization of this technique through the creation of environments, knowledge, and actors receptive to it. Apart from a micro-analytical study on a corporate scale, Power went so far as to present the significance of a full-blown "sociology of audits". His work has furthered understanding of phenomena of social change, notably the appearance of an audit society. From the same perspective, but focused more on the effects of tools and scientific models on the economy, Miller and O'Leary (2007) have shown how instruments such as *technology roadmaps*, or models such as Moore's Law, contributed to the construction of the microprocessor market.

Inspired by these English and French studies, other disciplines also adopted a theory of instruments to renew their research questions and subjects.

In the field of political science, phenomena of "managerialization" of public policy triggered recent developments that have strong intellectual similarities with management approaches of Foucauldian inspiration. Significantly, the volume edited by Lascoumes and Le Galès (2004) is also called *Gouverner par les instruments* ("Governing through instruments"). These authors propose to reassess the role of instrumentation in the government of public action. Policy-making is analyzed less through programmes than through its instruments and *"their significance in terms of power and of the diffusion of cognitive models"* (Lascoumes and Le Galès 2004). This research programme contributed to reviving political science's interest in in-depth empirical studies on public action (*Politix*, special issue n° 79, 2007).

In economic sociology, which maintains close relations with the preceding two research streams, an international research programme has been created in the past 15 years around the work of Michel Callon on the performativity of economics (see Callon and Muniesa 2003). By performativity, these authors mean the capacity of economics as a discipline to transform the economy as a thing through particular settings: calculative agencies (see Callon et al. 2007). The role of these calculative agencies (e.g. stock exchanges), consisting of actors and instruments performing calculation activities, are studied as key arrangements that enable us to understand how the incredible feedback loop between economic theories and the concrete organization of markets works. Even though they use the more colourful notion of market "equipment", it is the study of instrumentation of the market that constitutes the methodological point of entry and the empirical research subject at the heart of their work.

Situated instrumentation: instrument/activity interaction

Since the 1990s, in parallel with the growth of historical approaches to the development of instruments in organizations and society, we have witnessed the revival of a micro-analytical approach to management practices and to the role of instruments in organizations' activities. The starting point was the criticism of cognitivism – illustrated

by the failure of expert systems and artificial intelligence – which had tried to model human activity independently of its environment and of the exponential conjoint development of computer technology. Lucy Suchman (1987) was the instigator of a "situated" approach that repositioned all action in its context: action is situated in a material, physical, social, technical, etc. context; it is always instrumented by artefacts. Suchman explored problems of human/machine interaction, in the case of photocopiers and their users, during her many years at Xerox.

As a direct consequence of the development of contemporary instruments, notably in the field of computer technology, approaches based on the articulation between instruments and activities have appeared as a heuristic perspective in various disciplines (Rabardel 2005). This theoretical framework of instrumented activity *"participates in an anthropological base that we believe is common to the humanities, history, economics and the science of action"* (Rabardel 2005). In cognitive science, Hutchins (1994), for example, developed the notion of "distributed cognition" on the basis of his studies of the cockpit in commercial aeroplanes. He drew on the contributions of ergonomics and the psychology of activity to explain the fact that knowledge is not only the product of the human mind; it is also distributed in a socio-technical system consisting of humans and artefacts. These studies on situated activity and distributed cognition fuel a theoretical debate that is situated more at the level of activity (central in their approaches) than of collective action, and focuses on bipolar relations through interaction between instruments and individuals (man-machine interaction). Hence, those authors who adopt a situated approach implicitly or explicitly refer to the work of pragmatic philosophy (Dewey 1938; Peirce 1958). The situation is defined not *a priori*, but during the course of the activity, in the interaction between subjects and instruments (see Teulier and Lorino 2005). These approaches have expanded and deepened ethnographic research on organizations, initiated in France in the 1970s (see Moisdon 1984).

Cognitive ergonomics was the source of in-depth studies on the interaction between instruments and work, strongly inspired by the theory proposed by Vygotski (1930, in

Rabardel 2005) on mediated activity. Rabardel (1995) highlighted the twofold nature of the instrument: its artefactual components, and the *"social schemes of utilization of instrumented activity"* elaborated in the interaction between the instrument and the subject during the activity. The analysis of Moisdon (2005b) connects these approaches. He shows the twofold dimension of management instruments: knowledge provided for controlling, steering and orienting the activity; and knowledge that is fed back through use of the instruments. Thus, with regard to activity mediated by instruments, Rabardel – who, like Hatchuel and Weil (1992) studied expert systems – distinguished between *"productive activity, oriented towards doing and acting"* and *"constructive activity, oriented towards growth, maintenance and reconfiguration of the capacity to do and to act"* (Rabardel 2005). This approach offers a partial explanation to the problems that firms encounter with the introduction of new management instruments, and has therefore been applied in management science to gain insight into such difficulties. Lorino drew on these ergonomic studies, as well as on a pragmatic and semiotic approach to the interaction between instruments and activity, to explore this phenomenon in the case of setting up enterprise resource planning (ERP) at EDF (the French electricity utility) (Lorino 2005; Lorino and Peyrolle 2005). More recently, such authors as Detchessahar and Journé (2007) have studied the question of relations between the tool under observation and all the tools already in place, from a discursive angle and by developing the idea of a narrative engineering of management tools.

This stream of empirical and theoretical research on situated activity furthered understanding of the organizational and cognitive dynamics at play around management instrumentation. The question was then how to link up the situated analysis of these instruments with the creation of strategic objects and analyses in organizations. Studies on strategy as practice, which used ethnographic and micro-sociological approaches to investigate managers' situated practices, including the study of management instruments, might have been able to bridge this divide but as yet that has not happened (Whittington 2006; Whittington 2007; Jarzabkowski et al. 2007; Golsorkhi et al. 2006). Unlike the approaches mentioned above, management instruments have no clear epistemological status in studies on strategy as practice. As a comprehensive approach

is favoured, the management instrument is often studied simply as one medium of social interaction among others. Paradoxically, the situated study of managers' practices has led to the disappearance of the strategic object which, in a sense, dissolved under the researcher's gaze. Hence, by combining different focuses of analysis and taking into account broader processes of rationalization of which instruments are part, it may be possible to link these analyses to the formation of the objects of strategic reflection in organizations.

Conclusion: for a new research agenda on instruments

The aim of this genealogical study has been to gain perspective on the variety and fecundity of theoretical approaches to management instruments which increased rapidly from the 1960s, along with the extraordinary proliferation of such instruments in multiple fields (science, business, markets, etc.). Above all, it has brought to the fore the fact that there is not necessarily a difference in the nature of the instruments used in these different contexts. For instance, public policies, science and market activities mobilize calculation models and instruments for evaluation, coordination and delegation, which are very similar to those developed in firms. The instrument-based approach therefore enables us to grasp that which constitutes an invariant of organized action. In this respect, it is significant that management science and organization science have contributed to the theoretical and analytical foundations now adopted and adapted by other disciplines to study new objects such as the instrumentation of public policies or that of markets.

Two directions for further exploration emerge from current studies on instrumentation: first, historical approaches which study changes in managerial objects and techniques in the framework of collective rationalization of action; second, approaches to situated action, consisting of micro-analyses of joint changes in activities and in the take up of instruments. These approaches have made it possible to grasp more fully the essential dimensions of modern management that discourse analysis or managers' narratives

tend to hide: how to influence others' conducts; how to design and model complex economic, technical or social phenomena to be able to act on them and change them? Apart from such studies, what might the research agenda on instruments be? The current interest in design theories, involving a wide range of disciplines (engineering, management, ergonomics, architecture, etc.) points in one possible direction (see Hatchuel and Weil (eds) 2008): these theories can be used to study forms of instrumentation that are favourable to innovative design approaches. The development of freeware provides rich ground for studying this type of open innovation (Chesbrough 2003). But one then needs to go further than an all-encompassing analysis of information technologies, and to enter into the details of the models used to design these new instruments, of their languages, and of the problems of their interfacing (see Benkeltoum 2009).

The second direction, complementary to the first, is to go beyond the elementary analysis of management instruments and to study their coherent framing in strategic settings. Like a fractal object, the study of instruments can operate according to different angles of observation which do not necessarily imply a micro-analytical approach only. Studying the arrangement of instruments consists then in shifting the focus of the analysis towards the design of "interfaces" without assuming the existence of a grand "Architect" in charge of this action[8] (Aggeri 2008). Attention should therefore be paid to more open and distributed forms of collective innovation that combine a variety of instruments and involve different organizations.

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[1] This approach was proposed and theorized by Michel Foucault (see Dreyfus and Rabinow, 1984). It was adopted by Armand Hatchuel who proposed to consider the project of management sciences as the study of the historical formation of concepts, and of the joint transformation of doctrines and forms of collective action (Hatchuel 2000). For a transposition of this approach in the field of management, the reader is referred to: *Governement, organisation et gestion : l'héritage de Michel Foucault"*, Hatchuel A., Pezet E., Starkey K. and Lenay O. (Eds), Presses Universitaires de Laval (2005).

[2] Older examples can be found in Millard's historical work on Edison's organization of innovation (Millard 1990), in Callon's work on the networked management of technological innovation (Callon 1989), and in Abernathy's and Utterback's work on the management of technological innovation (Utterback 1978).

[3] On this point, the interested reader is referred to the book by Jean Favier: *De l'or et des épices, naissance de l'homme d'affaires au Moyen-Age* (Favier 1987).

[4] *"It seems that when it comes to management, the famous words 'all material support will be provided' still aptly sums up conceptions. Management seems to be essentially a matter of intent, which must of course be backed up by devices, but that is merely a technical concern, secondary to policy, as it should be. Thus, instruments such as ratios, nomenclatures, choice criteria, management systems, computerized or not, all become elements of an invisible technology whose harmful effects are much worse when they are left to operate unseen"* (Berry 1983).

[5] It was presented publicly for the first time at a Cerisy conference devoted to the future of operations research (cf. Heurgon E. (Ed.) (1978) *L'Avenir de la recherche opérationnelle*, Interéditions, Paris).

[6] The authors use the term rationalization not as an evolution towards enhanced forms of efficiency but as a constant renewal of value criteria. From a Foucauldian perspective, the idea is *"to treat the problem of reason historically and not metaphysically. (…) One has to limit the term rationalization to its instrumental and relative sense (…) and see how forms of rationalization fit into practices or systems of practices, and the role that they play there"* (Foucault, 1980, *Impossible prison*, Seuil, 1980).

[7] In a similar perspective, recent empirical work in the life sciences (Aggeri et al. 2007) has shown that the management of scientific equipment and of the competencies associated with it constitutes a strategic space around which research projects are elaborated and the governance of scientific research is organized.

[8] An illustration of this approach was developed in the field of extra-financial evaluation (see Acquier 2007; Acquier and Aggeri 2007).